Chapter 10
Planning and Scheduling Operations part 1

- Sales and Operations Planning
- Options and Strategies
- Operations Planning in Services

COOPERTIRES

- The 11th largest manufacturer. $3.4 Billion.
- Focuses on replacement tires.
- Key strategies: competitive cost, profit growth,….

2008/10 Reduced production due to supply shortage. No layoffs.

2009/10 Increased capacity by changing to 24/7 operations to meet a growing demand. Hired 200 more employees.

2013/3 Temporarily idled production at its Finlay plant due to high inventories and competition from Chinese-made tires.

2013/9 Phasing out small tires in favor of bigger tires with better designs. Implementation of new production planning software.

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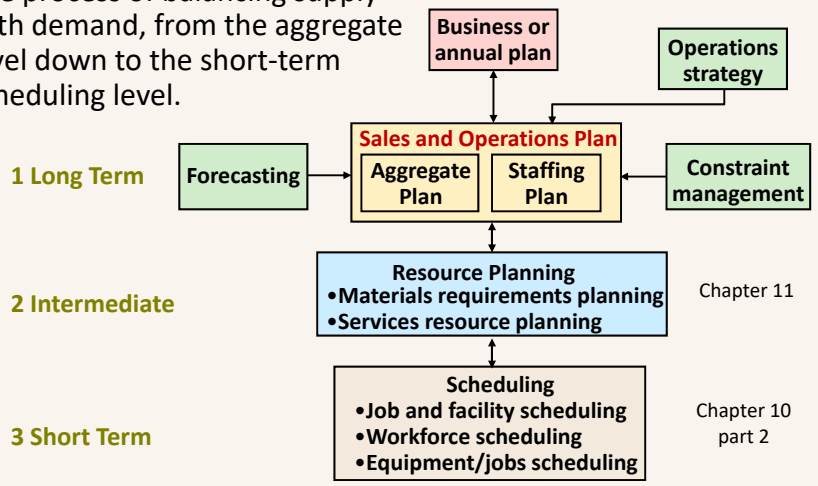
What is Operations Planning & Scheduling?

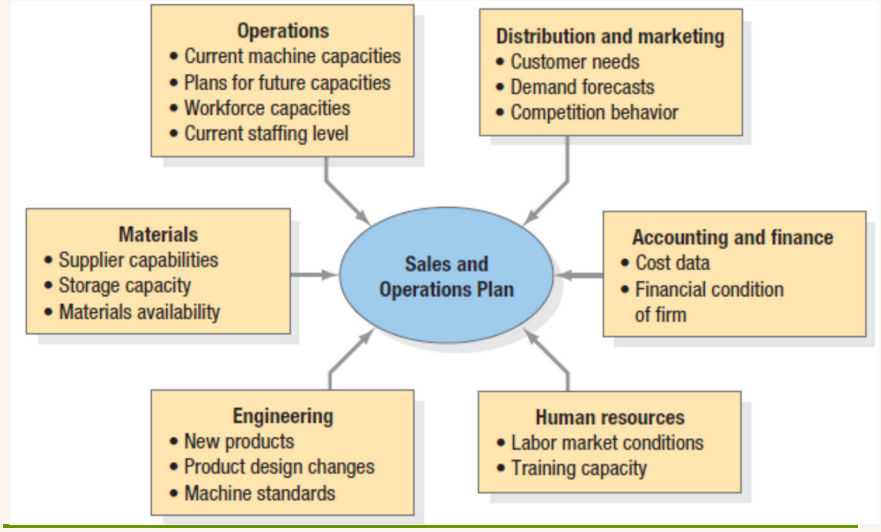
The process of balancing supply with demand, from the aggregate level down to the short-term scheduling level.



Level 1: Sales and Operations Planning

- Aggregation
  - Services or products: 物料與製程相似的product family
  - Workforce: 技能或職責相似的員工
  - Time: 整季或整年的計畫，以月或季為時間單位
- Information inputs
- Relationship to other plans
  - Business Plan or Annual Plan: a projected statement of income, costs, and profits. It reflects plans for market penetration, new product introduction, and capital investment.

Managerial Inputs to Operations Planning



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Levels in Operations Planning & Scheduling

- Level 2: Resource Planning
  - A process that takes sales and operations plans; process time standards, routings, and other information on how services or products are produced; and then plans the timing of capacity and material requirements.
  - 安排各規格產量，以週為時間單位
- Level 3: Scheduling
  - A process that takes the resource plan and translates it into specific operational tasks on a detailed basis.
  - 安排各站的工作排程，以天為時間單位

Why Planning?

- planning: It takes time to implement plans
- strategic: difficult to predict the timing and volume of demand for individual items. (aggregate)

- It can help synchronize flow throughout the supply chain 提供計劃讓上下游配合
- It is connected to the budgeting process

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Planning Options and Constraints

Supply Options
- Workforce Adjustment
- Utilization(overtime/undertime)
- Part-time workers
- Anticipation Inventory
- Subcontractors
- Vacation Schedules

Demand Options
- Pricing/Promotion
- Back orders/Stockouts
- New demand
- Complementary products

Constraints
- Capacity
- Inventory limit/safety stock
- Policies
  - Back orders
  - Overtime/Subcontracting
  - Workforce changes

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TYPES OF COSTS WITH SALES AND OPERATIONS PLANNING

Cost	Definition
Regular time	Regular-time wages plus benefits and pay for vacations
Overtime	Wages paid for work beyond the normal workweek exclusive of fringe benefits
Hiring and layoff	Cost of advertising jobs, interviews, training programs, scrap caused by inexperienced employees, exit interviews, severance pay, and retraining
Inventory holding	Capital, storage and warehousing, pilferage and obsolescence, insurance, and taxes
Backorder and stockout	Costs to expedite past-due orders, potential cost of losing a customer

Production Plan Example

Artic Air Company—April Sales and Operations Plan

Family: Medium window units (make-to-stock) *Unit of measure:* 100 units

	HISTORY									10-12				
										3rd	4th	Mos	Fiscal Year	Business
SALES	J	F	M	A*	M	J	J	A	S	3 Mos**	3 Mos	13–18	Projection ($000)	Plan ($000)
New forecast	45	55	60	70	85	95	130	110	70	150	176	275	$8,700	$8,560
Actual sales	52	40	63											
Diff for month	7	–15	3											
Cum		–8	–5											
OPERATIONS														
New Plan	75	75	75	75	75	85	85	85	75	177	225			
Actual	75	78	76											
Diff for month	0	3	1											
Cum		3	4											
INVENTORY														
Plan	85	105	120	125	115	105	60	35	40	198	321			
Actual	92	130	143											

85+(75-55)=105

92+(78-40)=130

DEMAND ISSUES AND ASSUMPTIONS

1. New product design to be launched in January of next year.

SUPPLY ISSUES

1. Vacations primarily in November and December.
2. Overtime in June–August.

Developing a Production Plan 1/2

1. Start at the end of the month. Roll forward. Update sales, inventory…
2. Participate and obtain new demand forecasts.
3. Develop a plan for each product family, subject to capacity and policies. Find a plan that best balances costs, customer service…
4. Meet with purchasing manager, plant manager, … Prepare alternative plans
5. Present and revise the new plan at the executive meeting.
6. Implement the new plan and perform resource planning.

Developing a Production Plan 2/2

2 取得產品家族的需求預測 $F_1, F_2, ..., F_T$

3 根據策略與限制，決定各期生產或銷售目標 (預測+安全庫存)

3.1 調整人力與資源以符合各期計畫產出 (假設產出以人力為主)

當期可用人力 = 前期原有人力 – (休假人力) + 新聘人力 - 解聘人力

Utilized Time = Workforce - (Vacation + Undertime)+ Hires - Layoffs

當期產出P_t = 正常產量 + 加班產量 + 外包產量

Total Output = Regular Production + Overtime + Subcontracting

3.2 預估各期的期末庫存

Inventory on hand I_t : 期初庫存 =上期期末庫存 (I_t <0 ⇒ backorder)

期末庫存 = $I_t + P_t - F_t \Rightarrow I_{t+1}$ (下期期初庫存)

Calculate Costs of a Production Plan

Output
- Regular cost per unit × Quantity of regular output
- Overtime cost per unit × Overtime quantity
- Subcontract cost per unit × Subcontract quantity

Vacation/Undertime/Hire/lay off
- Vacation/Undertime Cost per time unit × Amount of Vacation/Undertime 有薪假或人力閒置的成本
- Hire Cost per hire × Number hired
- Lay off Cost per layoff × Number laid off

Inventory
- Holding cost per unit × Average inventory 期初與期末庫存的平均 本書以期末庫存計算
- Backorder cost per unit × Number of back-order units

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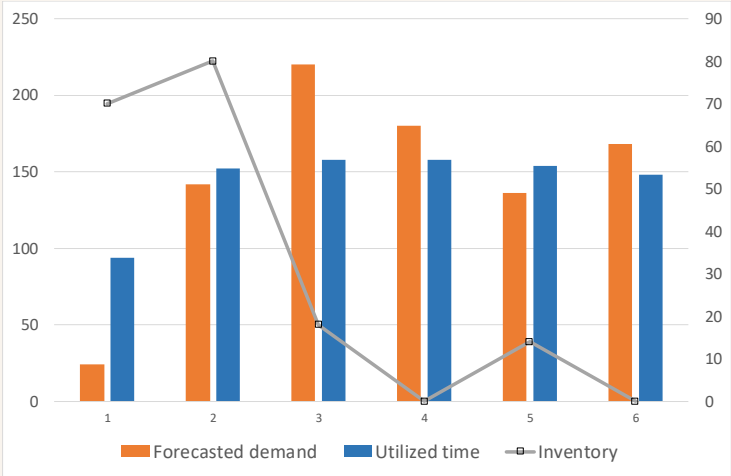
	1	2	3	4	5	6	Total
Inputs							
* Forecasted demand	24	142	220	180	136	168	870
* Workforce level	120	158	158	158	158	158	910
Undertime	6	0	0	0	0	0	6
Overtime	0	0	0	0	0	0	0
Vacation time	20	6	0	0	4	10	40
Subcontracting time	0	0	0	0	0	6	6
Backorders	0	0	0	4	0	0	4
Derived 120-6-20=94		120+38-6=152					
Utilized time	94	152	158	158	154	148	864
Inventory	70	80	18	0	14	0	182
* Hires	0	38	0	0	0	0	38
* Layoffs	0	0	0	0	0	0	0
Calculated 94-24=70		152+70-142=80					
Utilized time cost	$376,000	$608,000	$632,000	$632,000	$616,000	$592,000	$3,456,000
Undertime cost $4000	$24,000	$0	$0	$0	$0	$0	$24,000
Overtime cost	$0	$0	$0	$0	$0	$0	$0
Vacation time cost	$80,000	$24,000	$0	$0	$16,000	$40,000	$160,000
Inventory cost $40	$2,800	$3,200	$720	$0	$560	$0	$7,280
Backorders cost	$0	$0	$0	$4,000	$0	$0	$4,000
Hiring cost $2400	$0	$91,200	$0	$0	$0	$0	$91,200
Layoff cost	$0	$0	$0	$0	$0	$0	$0
Subcontracting cost	$0	$0	$0	$0	$0	$43,200	$43,200
				$1000×4		$7200×6	
Total cost	$482,800	726,400	632,720	636,000	632,560	675,200	$3,785,680



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Sales and Operations Planning Strategies

Chase Strategy

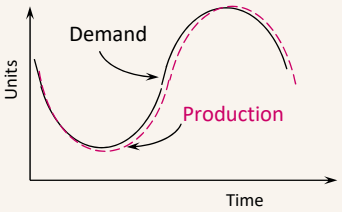
- Use all supply options to match the demand forecast

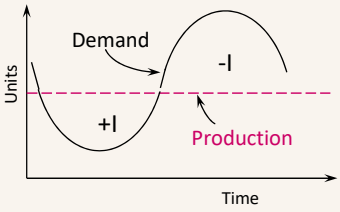
Level Strategy*

- keeps the workforce and output constant, allows backorders and/or inventory

Mixed Strategy

- A strategy that considers the full range of supply options





Example 10.1: A Staffing Plan for a Large DC

Time period	1	2	3	4	5	6	Total
Forecasted demand	6	12	18	15	13	14	78

單位：每人每期的揀貨量

Currently, 10 part-time pickers are employed. Each part-time picker can work a maximum of 20 hours per week on regular time.

a. The size of training facilities limits the number of new hires to 10.
b. No backorders are permitted; demand must be met each period.
c. Overtime cannot exceed 20 percent of the regular-time capacity.

Regular-time wage rate	$2,000/time period
Overtime wages	150% of the regular-time rate
Hires	$1,000 per person
Layoffs	$500 per person

Example 10.1: Chase Strategy

Adjust the workforce as needed to match demand. 不讓人力短缺或過剩

	1	2	3	4	5	6	Total
Inputs							
Forecasted demand	6	12	18	15	13	14	78
Workforce level	6	12	18	15	13	14	78
Undertime	0	0	0	0	0	0	0
Overtime	0	0	0	0	0	0	0
Derived							
Utilized time	6	12	18	15	13	14	78
Hires	0	6	6	0	0	1	13
Layoffs	4	0	0	3	2	0	9
Calculated							
Utilized time cost	$12,000	$24,000	$36,000	$30,000	$26,000	$28,000	$156,000
Undertime cost	$0	$0	$0	$0	$0	$0	$0
Hiring cost	$0	$6,000	$6,000	$0	$0	$1,000	$13,000
Layoff cost	$2,000	$0	$0	$1,500	$1,000	$0	$4,500
Total cost	$14,000	30,000	42,000	31,500	27,000	29,000	$173,500

Example 10.1: Level Strategy

- In order to minimize undertime, the maximum use of overtime possible must occur in the peak period. 以尖峰人員需求為基準，不調整
- The most overtime allowed is 20% of the regular-time capacity, *w*

  1.20*w* = 18 pickers required in peak period (period 3)

$$w = \frac{18}{1.20} = 15 \text{ pickers}$$

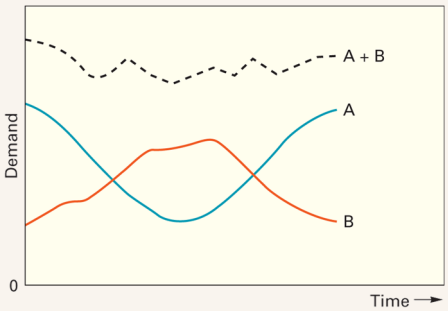
- Because the staff already includes 10 pickers, the manager should immediately hire 5 more at the start of the plan.
- Instead of paying undertime, each picker's day is shortened. 人力過多時，縮減工時而不裁員

Example 10.1: Level Strategy

	1	2	3	4	5	6	Total
Inputs							
Forecasted demand	6	12	18	15	13	14	78
Workforce level	15	15	15	15	15	15	90
Undertime	9	3	0	0	2	1	15
Overtime	0	0	3	0	0	0	3
Derived							
Utilized time	6	12	15	15	13	14	75
Hires	聘15人，每人 5	0	0	0	0	0	5
Layoffs	做6/15的工時 0	0	0	0	0	0	0
Calculated							
Utilized time cost	$12,000	$24,000	$30,000	$30,000	$26,000	$28,000	$150,000
Undertime cost	$0	$0	$0	$0	$0	$0	→ $0
Overtime cost	$0	$0	$9,000	$0	$0	$0	$9,000
Hiring cost	$5,000	$0	$0	$0	$0	$0	$5,000
Layoff cost	$0	$0	$0	$0	$0	$0	$0
Total cost	$17,000	24,000	39,000	30,000	26,000	28,000	$164,000

Smooth Out Capacity Requirements

unevenness in demand ⇒ inventory (make to stock) or lost sales
週期的需求起伏



Identify products or services that have complementary demand patterns.

Operations Planning in Services

- Demand for service can be difficult to predict (異質性)
- Capacity availability can be difficult to predict (易滅性)
- Services occur when they are rendered (同時性)
- Labor flexibility can be an advantage in services

高接觸服務
- 產能為人力與時間，需決定各時段的人力需求
- 計畫重點：減少人力閒置、減少顧客流失。

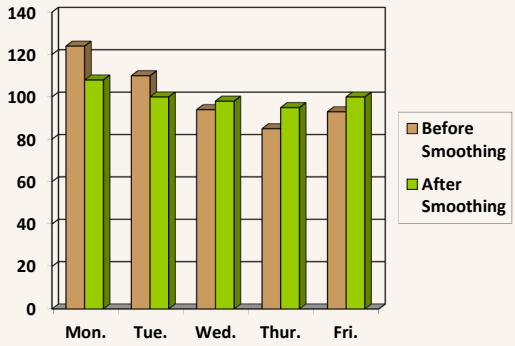
旅遊業(航空、旅館)
- 產能易滅，需決定各航線的運量與各種費率的座位數
- 計畫重點：固定成本高，變動成本低，增加營收就增加利潤

Appointments: 診所開放預約名額

Too many walk-in patients on Mondays at a health clinic.

Smoothing Demand by Scheduling

Day	Appointments
Monday	84
Tuesday	89
Wednesday	124
Thursday	129
Friday	114



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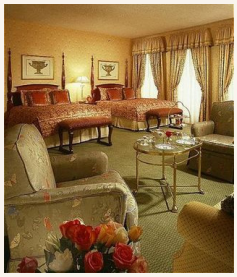
Revenue Management

Varying price and allocating capacity at the right time for different customer segments to maximize revenue. (p.299)

- The Park Hyatt Hotel has 118 King/Queen rooms.
- $159 (low fare) discount fare targeting leisure travelers.
- Regular fare is $225 targeting business travelers.

觀光客：事先計畫，尋找優惠價格
商務客：臨時訂房，不在意是否有折扣
1.如果不限制早鳥優惠訂房，會如何影響營收？
2.若限制早鳥優惠，應保留幾成給商務旅客？

計畫應隨假期與季節調整



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